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CRUISE REPORT

February, 2004

ASSESSMENT OF FISH COMMUNITIES ASSOCIATED WITH OFFSHORE SAND BANKS AND SHOALS IN THE NORTHWESTERN GULF OF MEXICO

Cruise Sabine 2003-01
R/V Eugenie, LUMCON
Sabine Bank, Texas
19-25 July 2003

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U.S. Department of the Interior
U.S. Geological Survey

MMS U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

U.S. Geological Survey
Eastern Region
Florida Integrated Science Center

Minerals Management Service
OCS Sand and Gravel

ASSESSMENT OF FISH COMMUNITIES ASSOCIATED WITH OFFSHORE SAND BANKS AND SHOALS IN THE NORTHWESTERN GULF OF MEXICO

Cruise Report
Cruise: Sabine-2003-01
29 September 2003

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Cover Image: Bonnethead shark, *Sphyrna tiburo*, collected in the center of Sabine Bank (Station Number: Sabine 2003-01-066).

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Introduction

The benthic habitat of the continental shelf is not a homogeneous region of mud habitat, but also contains natural sand banks. As local sand resources are depleted, requests are being made for the use of identified Minerals Management Service Outer Continental Shelf (MMS-OCS) sand resources for coastal restoration activities. Natural sand banks represent an exploitable sand resource for beach renourishment and stabilization. Some of the raised sediment banks under consideration may provide a distinctive habitat. The relief of these banks may serve as a special habitat resulting in benthic community differences between areas on the bank, in the surrounding areas, and in the ecotone between the bank and surrounding areas. Bank habitat may be of particular importance as nursery habitat for juvenile fishes including red snapper, *Lutjanus campechanus* Poey, a commercially important species (Szedlmayer and Howe, 1997). MMS Sand and Gravel has in turn initiated scientific studies to examine the potential impacts of sand mining on the biological communities of offshore borrow areas.

Background

Extensive beach restoration projects along the Gulf Coast of the United States are placing increased pressure on the known offshore sand resources, within state waters. The region has experienced serious erosion, subsidence, and loss of coastal shorelines. Most usable sand deposits, for coastal and beach restoration, occur within the submerged offshore shoals, on the inner continental shelf. However, such areas may be important ecologically and economically, representing essential fish habitat (EFH) for exploited resource fish species. The relief of these banks may provide a special microhabitat with a different benthic community residing within on-bank, off-bank, and ecotone areas based upon a combination of sediment grain size and energy regime (Neuman & Able 1998, Wright et al. 2000, Bergen et al. 2001). Many coastal fish species settle out on sand banks as juveniles and exploit the shoal areas for both habitat and feeding purposes. Juvenile fishes are less mobile and can be habitat specific such that small changes (i.e., the presence of biogenic structure) may make the difference between the habitat being unacceptable versus essential. Small changes in habitat quality that affect either the growth and/or survival of juveniles may also have a large impact on fish population size (Diaz et al. 2003). The potential for long-term adverse impacts to organisms both demersal fishes and invertebrates, as a result of offshore dredging, may occur if the physiography of a shoal feature is altered significantly. Little information is available relative to the habitat these offshore shoal areas provide for fish species. Before sand resources are exploited, detailed and specific information on biological communities and habitat relationships of organisms is needed. This information is vital if adverse impacts to fish species that inhabit the shoal regions are to be avoided or mitigated in the future.

Fish assemblages will be quantitatively evaluated in potential sand resource areas in the northwestern Gulf of Mexico to assess the relationships among sediment types and the spatial distribution of communities. This geo-referenced information will be used to assess the potential for disturbance to biotic communities from sand mining.

Goal

The goal of this project is to provide a quantitative community assessment for benthic habitats in shallow shelf environments of the northwestern Gulf of Mexico, with emphasis on Sabine Bank, a potential source of sand resources.

Cruise Objectives

As part of the USGS investigation, Texas A&M University has been contracted to provide detailed maps of bottom sediment types based upon the interpretation of ground-truthed, side-scan sonar backscatter data. The contract also requires a CHIRP seismic sub-bottom profiling, to provide information on sediment facies, and to facilitate sediment characterization and classification. Additionally, single-beam depth surveys will be conducted during the side-scan transects to provide high resolution bathymetry information. The first of two data gathering cruises for this work was conducted on October 6-9th, 2003. The resulting data has not been analyzed yet and another data collection cruise has been scheduled for late December, 2003, to January, 2004. Once this data is processed, it will be used by the USGS on future sampling cruises, and will improve the precision and accuracy of the assessment of discrete sediment-based habitats on the potential sand resource area of Sabine Bank.

The objectives of the USGS July, 2003, sampling/gear testing cruise were:

- Reconnaissance fish sampling to ground truth our sampling methodology, including the documentation of a resident species list.
- Quantitative assessment of any dominant demersal fish community (including juvenile red snapper) differences between the Sabine Bank habitat versus adjacent deeper waters.
- Comparative quantitative assessment of any dominant demersal fish community (including juvenile red snapper) differences between the center versus edge habitat of Sabine Bank.
- Testing of effective trawl collection on sand bank habitat including examining such factors as trawl specification (i.e., tickler chain vs. cookies), speed, and duration.
- Testing of effective sediment collection using a modified box grab.
- Testing of effective water parameter monitoring using a SEABIRD SBE-19Plus self -recording Conductivity, Temperature, and Depth profiler (CTD), including testing of the protective cage.
- Testing of the efficiency and logistics of using GPS navigational equipment attached to the trawl itself to record its track in coordination with onboard navigational software (GeoTracker).

Methods

Study Area

The primary study area included Sabine Bank and adjacent open-bottom areas. Sabine Bank (Figure 1) is located 28 km South of the mouth of Sabine Pass, at the Texas/Louisiana border, and approximately 74 km East of the mouth of Galveston Pass. The main body of the bank is 33 km long, extending to the WSW of the dredged channel leading to Sabine Pass. At its widest point, the bank is 7 km wide. Another part of Sabine Bank, about 17 km long by 4 km wide, extends ENE from the Sabine Pass channel.

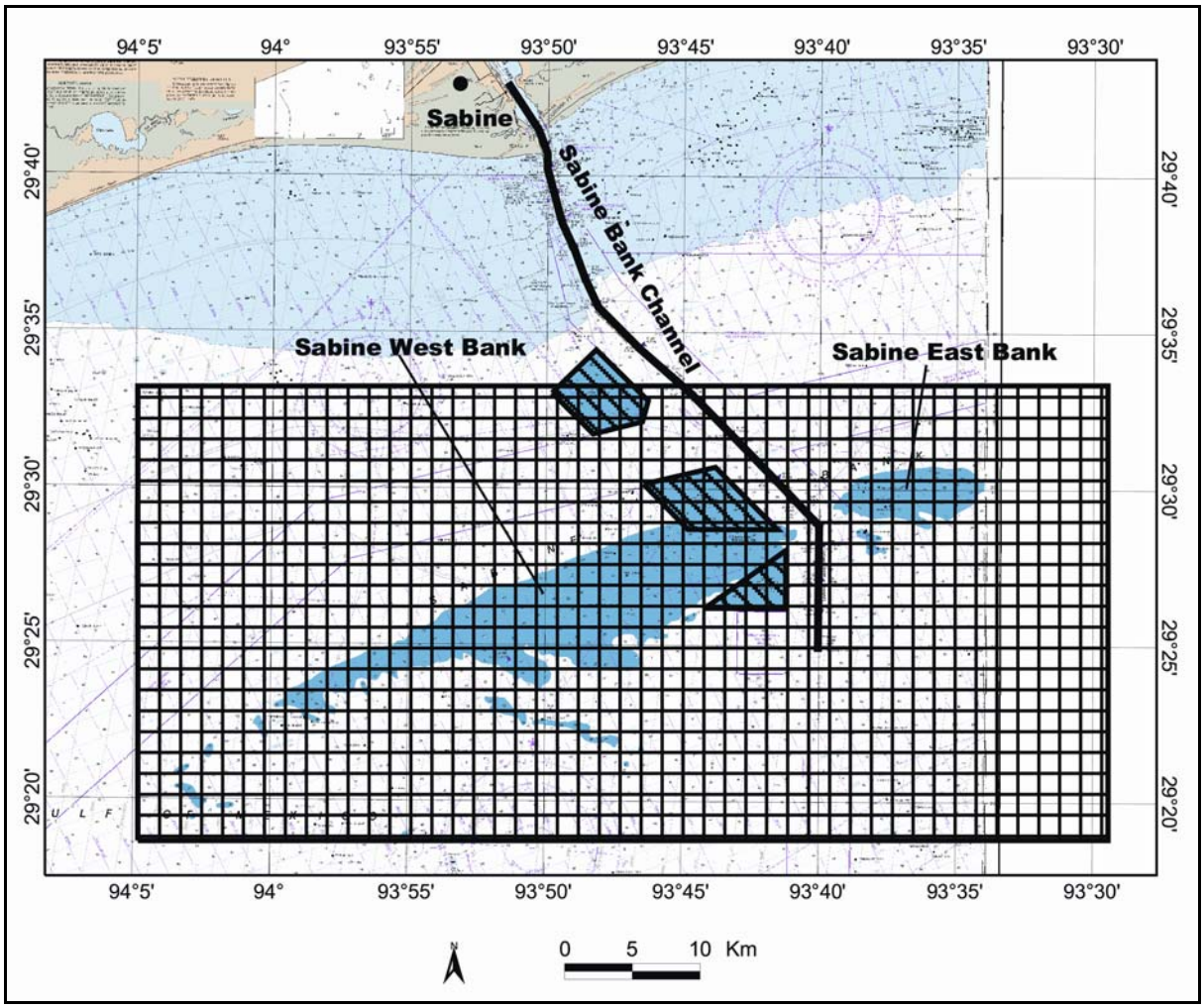

Figure 1. Sabine Bank, excerpted from NOAA Chart No. 11330. Patterned blue areas indicate the extent of the Disposal Areas. The grid is composed of 1235 meter squares, used to choose locations of random trawl samples.

Sampling Protocol

Station Selection – A virtual grid was projected over Sabine Bank with a cell size of 1,235 m^2 (Figure 1). This cell size roughly corresponds to the distance covered by a 20 minute trawl at 2 knots. Surrounding off-bank areas were also included up to 2,470 m from the edge of the bank. Cells which contained submerged pipelines or other obstructions, noted on the NOAA Nautical Chart No. 11330 (Figure 1), which would prevent trawling success, were excluded. There are areas on the bank which are designated as "Disposal Areas" on the nautical chart (Figure 1). Samples from this area were kept separate to estimate if there are any differences between disposal and non-disposal areas. It is possible that sediment differences may exist which leads to differential faunal use. Cells on the bank were then classified as to either "bank interior" or "bank edge". Edge cells were determined to be cells that contained any combination of on and off-bank areas, while interior cells were exclusively on the bank. After classification, ten random bank interior, bank edge, and off-bank cells were selected as sampling stations.

Reconnaissance Trawl Sampling – At each sampling station, one trawl was completed. After preliminary sampling, it was decided, due to low benthic fish abundance*, that all trawls would be fifteen minutes in duration at a towing speed of 2.0 to 2.5 knots. A 6 m otter trawl was used with 2 cm mesh, 0.62 cm mesh liner, and a 0.6 cm tickler chain (Figure 2).

Figure 2. The 6 m otter trawl used for fish sampling.

The position of the ship was recorded at all times using a mounted Garmin GPS unit and Blue Marble Geographic's program GeoTracker. GeoTracker, when used with an ArcView extension, will allow for the visualization (and recording) of the ship's position relative to the bank. A Garmin GPSMAP 76S was attached to the cod end of the trawl by using a 5-float cradle

(Figure 3). The use of the secondary GPS unit allowed us to determine the actual track of the trawl over the bottom, as compared to that obtained from the GeoTracker positioning system. The GPS unit was attached to the cradle using a waterproof Otter Box which provided a dry environment and also allowed for satellite reception.
*(see comment on hypoxia below)

Figure 3. The float used to attach the GPS unit to the trawl.

All demersal and non-schooling pelagic fish (and shrimp over 100 mm total length) caught in the trawl were recorded to species and either a standard, fork, or total lengths were taken to the nearest millimeter (Figure 4). The abundance of all pelagic schooling fish (e.g., *Anchoa mitchilli, Anchoa hepsetus, Chloroscombrus chrysurus, Opisthonema oglinum*) was recorded, and lengths were taken from thirty randomly selected individuals of each species. All fish collected were identified to species under the supervision of Dr. John Caruso from the University of New Orleans. Dr. Caruso has over twenty years of experience with Gulf of Mexico fish taxonomy. Once a fish was identified to species (and a length measurement taken) it was discarded. Any fish which could not be positively identified to species was preserved in 10% formalin and are currently archived at the University of New Orleans for further taxonomic clarification.

Angling – To supplement trawl sampling, angling was performed to potentially catch species or larger individuals which may avoid the trawl. Specifically, demersal fish species were targeted using hook and line gear (six foot fiberglass poles with Penn 320GT reels and 40 lb main line). Cut bait, either squid or fresh caught fish, was weighted for bottom fishing.

Figure 4. USGS scientists recording individual fish species abundance and length.

Water Parameter Sampling – A SEABIRD SBE-19Plus self-recording CTD profiler was used to measure water parameters (Figure 5). The CTD records water temperature (0.000 ^{o}C), conductivity (0.00000 S/m), pressure (depth, 0.00 m), and oxygen concentration (0.0000 mg/L). With further processing of the CTD data, salinity (0.000 PSU), density (0.000 kg/m^3), and oxygen saturation (0.000 %) can be calculated. After the completion of each trawl sample, the boat returned back to the midpoint of each trawl track, and a water column profile was taken.

Figure 5. Seabird CTD Deployment, in a custom protective cage for water parameter measurements.

Sediment Collection – After the completion of each trawl sample, the boat returned back to the midpoint of each trawl track. The box grab was deployed to collect a relatively undisturbed plug of sediment (Figure 6). A subsample was taken from each successful grab using a 2.54 cm diameter corer to a depth of 5-8 cm. The subsample will be used to supplement and ground-truth the information obtained from Texas A&M's side-scan sonar mapping.

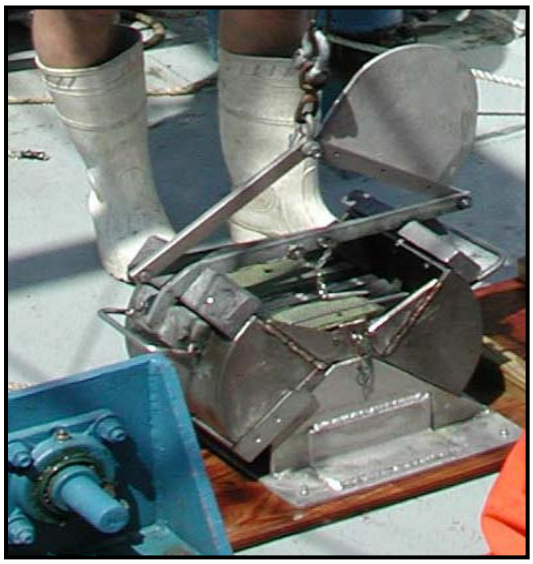

Figure 6. The custom box grab (K. Sulak design) used for sediment collection.

Research Vessel - The R/V Eugenie, a 17.6 m research vessel, from the Louisiana Universities Marine Consortium (LUMCON), Cocodrie, Louisiana, was used as the sampling platform for this cruise (Figure 7). The vessel accommodates four scientific crew and twelve hours of sampling per day. The Eugenie has a two day sea-keeping limit before having to return to port.

Figure 7. The R/V Eugenie based out of LUMCON used for all sampling.

Results

Trawl Results – Thirty-four trawl tows were accomplished including thirteen tows on the interior of the bank (Figure 8), ten tows on the bank edge (Figure 9), and eleven tows off-bank (Figure 10). Two of the interior tows were made in the Disposal Area located on the east side of Sabine Pass to provide an indication of any potential differences between this area and the rest of the bank. Additionally, each tow was classified by location east or west of Sabine Pass Channel. *A-priori*, it was hypothesized that the east side of the bank might be different due to its proximity to the Mississippi River. The use of the Garmin MAPGPS 76S attached to the trawl's cod end was successful in determining the actual track of each trawl (example - Figures 8 through 10, on the following pages).

Thirty-three fish species were collected with a total catch of 12,711 fish (Table 1). Fifteen of the species collected were either demersal species or species which may directly rely upon bottom food resources (Table 1). Mean fish abundance per trawl was greatest in the off-bank samples and over two to four times the average abundance found on the bank (Figure 11). The edge samples contained double the mean fish abundance per trawl compared to the interior samples. Fish abundance was over two times greater on the east side of Sabine Pass compared to the west side (Figure 12).

Very few demersal fish species were found, from interior bank samples. With the possible exception of the hardhead catfish, *Arius felis*, and Atlantic croaker, *Micropognias undulatus*, demersal fish were in extremely low abundance. Demersal fishes accounted for 267 (or 2.1%) of the total catch (Table 1) and displayed a different pattern from that of all fish species combined (Figures 11 & 12 vs. 13 & 14). Demersal fish abundance was two to four times greater on the interior and edge of the bank compared to off-bank samples (Figure 13). Mean fish abundance per trawl was also greater in the interior bank samples compared to the edge (Figure 13).

Although demersal fish abundance is low, the results suggest that the bank and more specifically the interior of the bank is important demersal fish habitat. In contrast, demersal fishes were over two times greater on the west versus east side of Sabine Channel (Figure 14).

Notably absent were flatfishes (e.g., flounder, tonguefish), gobies, and blennies. Only one searobin, *Prionotus rubio*, was collected (Table 1). Likewise, cut bait angling resulted in the collection of only four *A. felis* of the same size range collected during trawling.

Water Parameter Results – Thirty-three CTD water column profiles were taken (Figure 15). Results indicate that the study area was not hypoxic at the time of the cruise with a mean dissolved oxygen level of 4.4 mg O_2/L being recorded on the bottom. Some stations were very close to hypoxic, with a minimum level of 2.1 mg O_2/L being recorded on the center of Sabine Bank west of the channel. Bottom salinities ranged from 26.7 to 31.4 ppt with a mean salinity of 29.3 ppt. Temperature varied by only one degree between all sampling stations with a mean of 28.9°C.

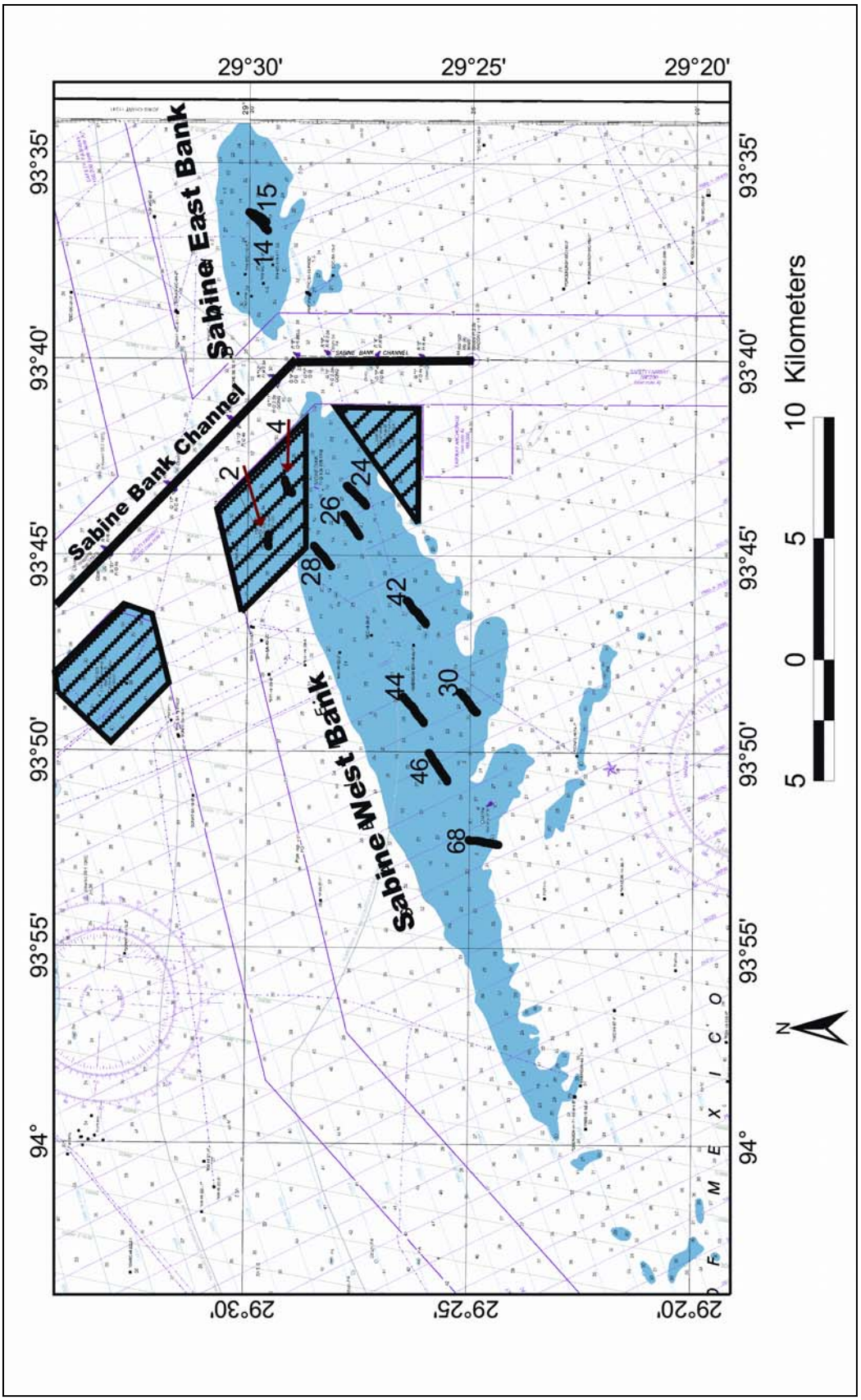

Figure 8. Trawl sampling stations in the interior of Sabine Bank, including stations 2 and 4 in the Desposal zone. Patterned blue areas indicate the extent of the Disposal Areas.

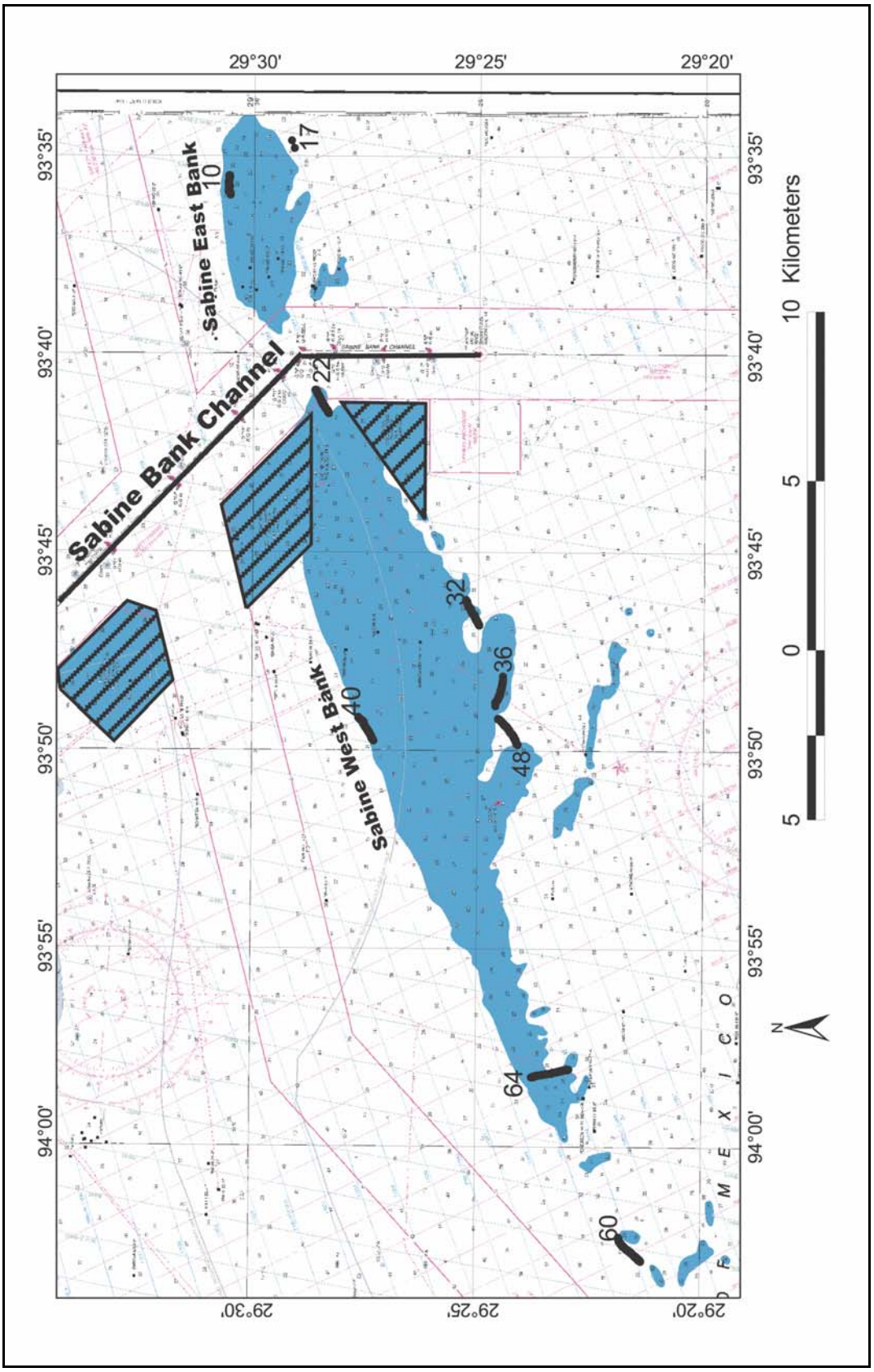

Figure 9. Trawl sampling stations on the edge of Sabine Bank. Patterned blue areas indicate the extent of the Disposal Areas.

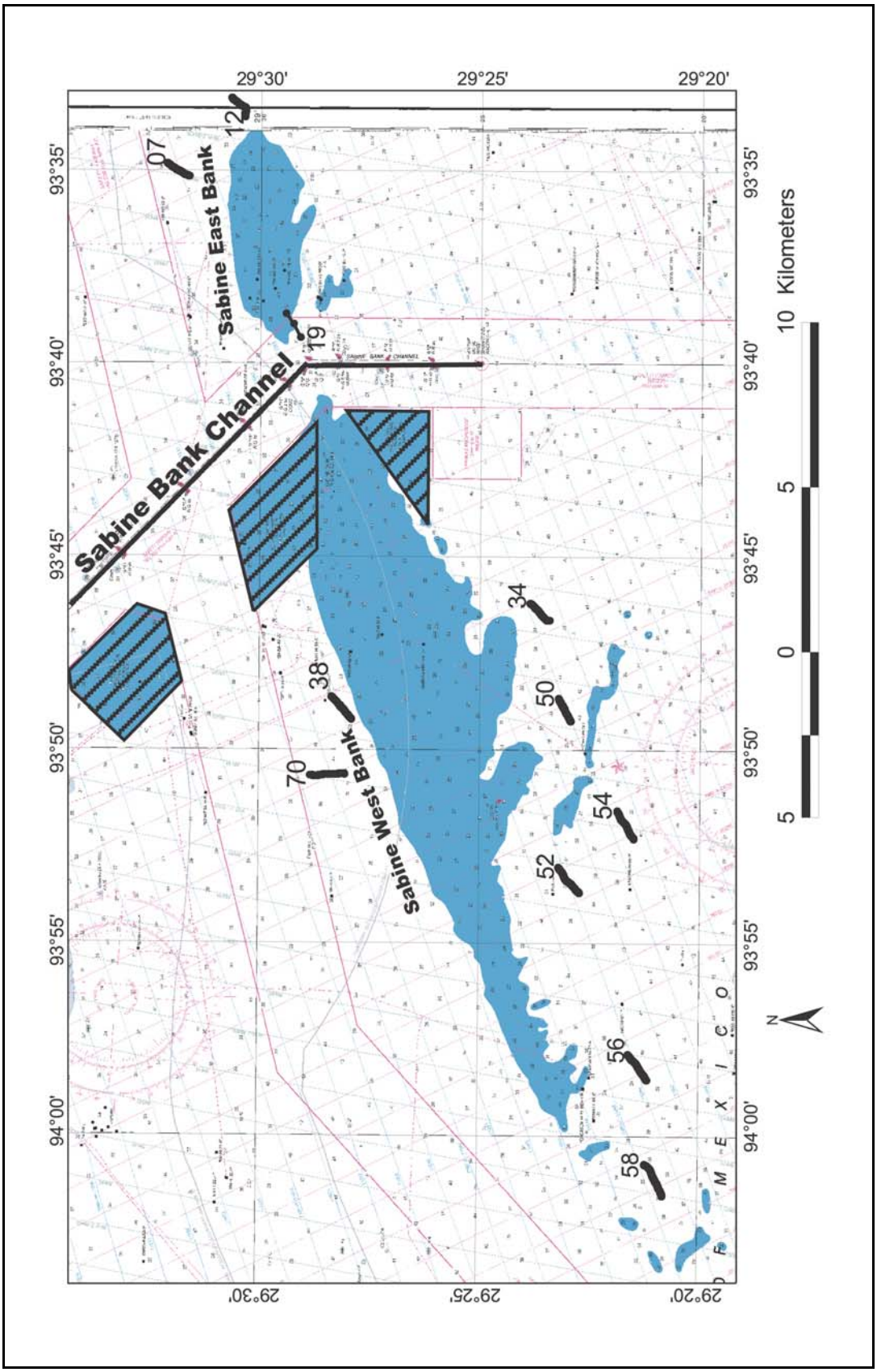

Figure 10. Trawl sampling stations adjacent (off bank) to Sabine Bank. Patterned blue areas indicate the extent of the Disposal Areas.

Table 1. Fish species caught in the trawl on the Sabine 2003-01 cruise ranked in order of abundance. *Species which can be considered demersal.

SCIENTIFIC NAME	COMMON NAME	TOTAL
Anchoa mitchilli	bay anchovy	5691
Chloroscombrus chrysurus	Atlantic bumper	3227
Anchoa hepsetus	striped anchovy	2787
Opisthonema oglinum	Atlantic thread herring	356
Anchoviella perfasciata	flat anchovy	181
Micropogonias undulatus *	Atlantic croaker	118
Arius felis *	hardhead catfish	57
Lagodon rhomboides *	pinfish	34
Peprilus alepidotus	harvestfish	33
Peprilus burti	Gulf butterfish	29
Leiostomus xanthurus *	spot	28
Harengula jaguana	scaled sardine	18
Chaetodipterus faber	Atlantic spadefish	15
Cynoscion nothus *	silver seatrout	14
Hemicaranx amblyrhynchus	bluntnose jack	13
Trichiurus lepturus	Atlantic cutlassfish	6
Cynoscion sp. juvenile *	juvenile trout	4
Sphoeroides parvus *	least puffer	4
Caranx crysos	blue runner	3
Selene setapinnis	Atlantic moonfish	3
Sphyrna tiburo	bonnethead	2
Larimus fasciatus *	banded drum	2
Lutjanus synagris *	lane snapper	1
Rhizoprionodon terraenovae	Atlantic sharpnose shark	1
Stellifer lanceolatus *	star drum	1
Syngnathus pelagicus *	Sargassum pipefish	1
Dasyatis sayi *	bluntnose stingray	1
Monacanthus hispidus	planehead filefish	1
Orthopristis chrysoptera *	pigfish	1
Pogonias cromis *	black drum	1
Prionotus rubio *	blackwing searobin	1
Rachycentron canadum	cobia	1
Sphyraena barracuda	great barracuda	1
Total		12711

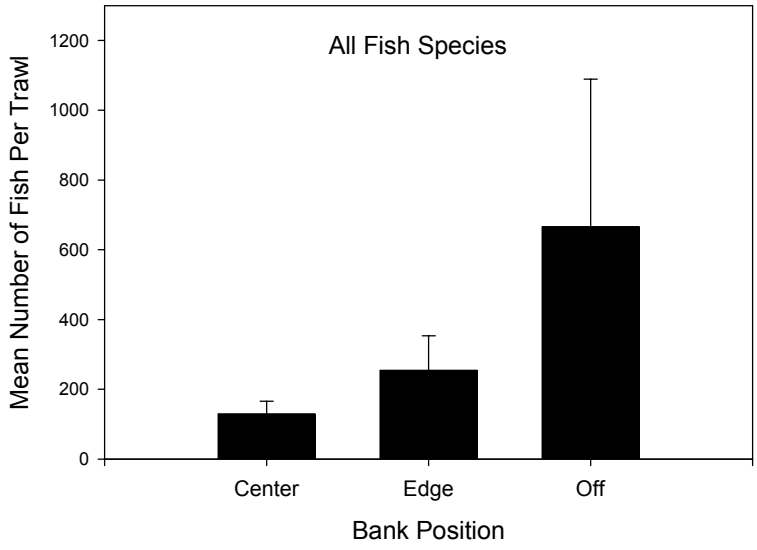

Figure 11. Trawl catch data (avg.±s.e.) for all fish depending upon their position within the seascape.

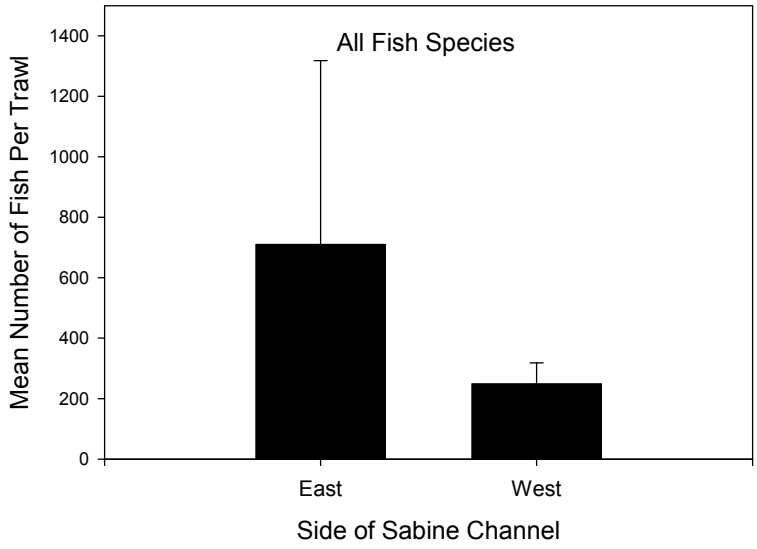

Figure 12. Trawl catch data (avg.±s.e.) for all fish based upon their location in reference to Sabine Channel.

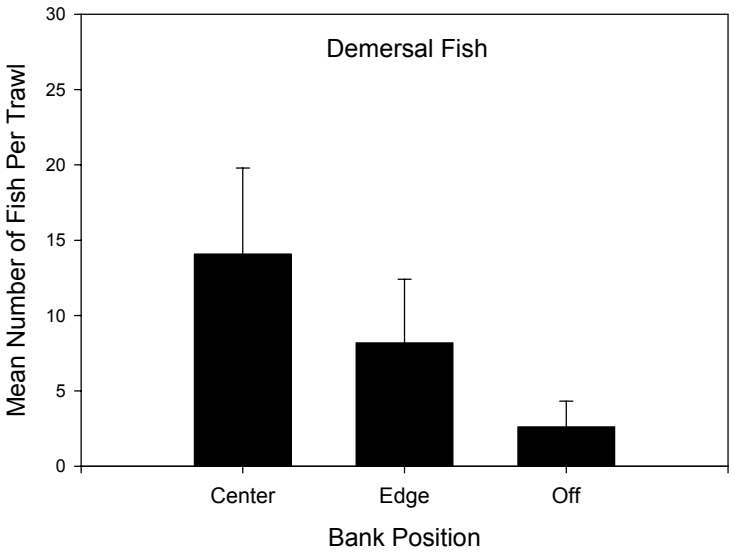

Figure 13. Trawl catch data (avg.±s.e.) for demersal fish depending upon bank location.

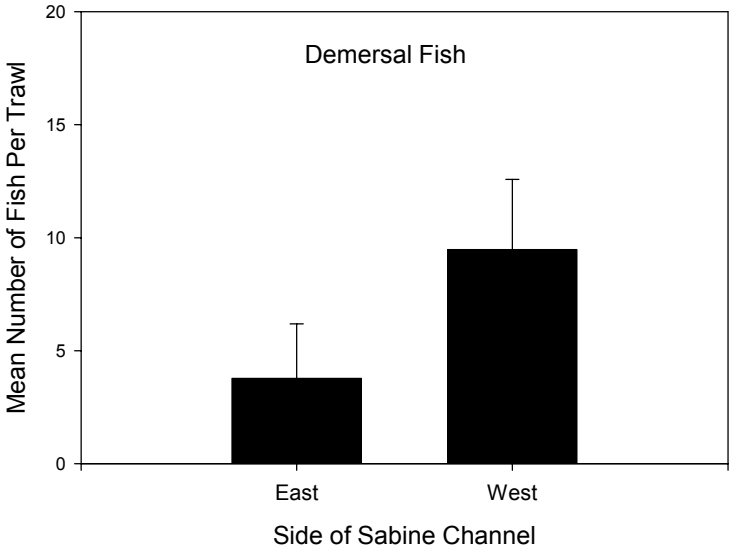

Figure 14. Trawl catch data (avg.±s.e.) for demersal fish based upon their position in reference to Sabine Channel.

Sediment Results – Only three successful sediment grabs were obtained (Figure 15). The winch was not fast enough to trigger the box grab on its own. We were able to get the grab to trigger when we lowered it by hand, but unfortunately it did not seem to penetrate the sediment. Bottom current was possibly too high. For future cruises, we will correct this problem by allowing the boat to drift with the current so the wire stays vertical, and by exploring the use of a different winch.

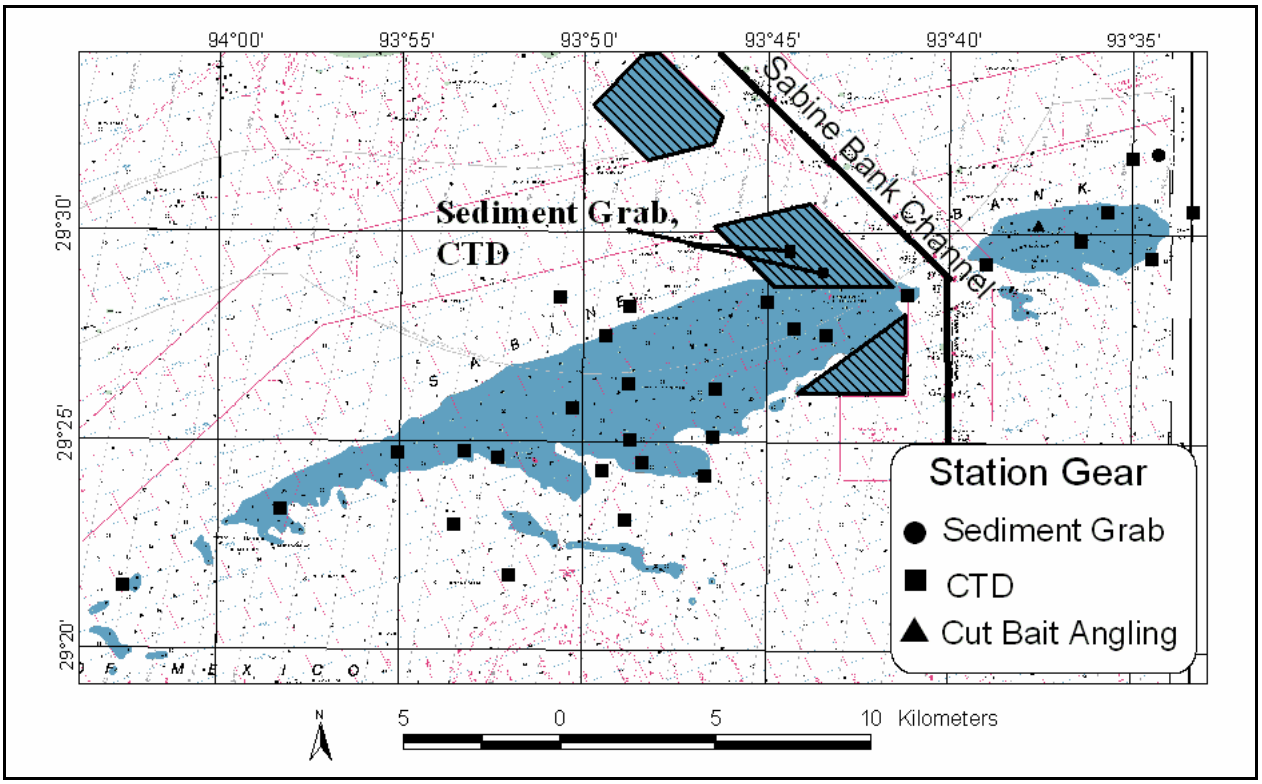

Figure 15. Sediment grab, CTD, and angling stations, for the Sabine-2003-01 Cruise. Patterned blue areas indicate the extent of the Disposal Areas.

Issues of Concern

Hurricane and Hypoxia - In recent years the nearshore environment off of Louisiana has experienced hypoxic conditions (< 2 mg of O_2 / L) which impact nekton and benthos (Harper et al., 1981; Renaud, 1986; Rabalais, 2002). The hypoxic zone covers more than 20,000 km^2 of bottom (Rabalais et al., 2002), and Sabine Bank has been in this zone during certain years. Hypoxia can occur from late February and extend through early October with the most severe conditions from June-August. The reason for hypoxia is two-fold; eutrophication from the Mississippi River results in increased water column and benthic respiration; summer

stratification of the water column prevents subsurface oxygen mixing.

Although Sabine Bank is just west of the area which has been monitored annually since 1985, hypoxic areas off the Texas coast have been previously been reported (Rabalais et al., 2002). Based upon data from Rablais et al. (2002), the Sabine area has greater than a twenty-five percent frequency of occurrence for annual summer hypoxia. It is unknown if Sabine Bank was hypoxic in early 2002 but one week prior to our sampling cruise the eye of hurricane Claudette (Appendix A) passed within 150 miles of Sabine. Water stratification can be broken up by the presence of tropical storms (Rabalais et al., 2003) and may explain why non-hypoxic conditions were found during our cruise (Appendix B). It should be noted that in general oxygen levels were still low (< 4.0 mg of O_2/L) on some parts of the bank. If Sabine Bank had only been under normoxic conditions for less than a week this might explain why so few demersal fishes were caught (Moser et al., 1996). This might also explain why we found very few benthic invertebrates in our trawl samples, perhaps including opportunistic species. Opportunistic or pioneering species are highly mobile and able to colonize, or reproduce and expand rapidly from depleted levels following the return of favorable conditions. Less mobile demersal species may require more time and may not return if an area becomes hypoxic on a regular basis.

Research Vessel – The R/V Eugenie was acceptable for our gear testing cruise, but will not be a first choice for further missions. The Eugenie does not have acceptable laboratory space for proper sorting, measurement, and photography of collected specimens. Additionally, transit time from Sabine Bank to Port Sabine, TX was three hours, therefore in the future a vessel that can stay out on the bank for more than two days at a time will be requested. The winch on the Eugenie was also unsatisfactory for the use of our sediment grab and in the future a vessel with a winch that can be free wheeled will be sought.

Project Itinerary (FY2003 – 2005)

Year I - FY2003
Summer 2003
- Sediment collection, ground-truthing - Completed
- Reconnaissance fish sampling including gear testing and comparisons - Completed
- Begin synthesis of ground fish survey database - Ongoing

Fall 2003
- Mapping (sidescan, CHIRP, and single-beam bathymetry) – 1 of 2 Cruises Completed
- Synthesis of ground fish survey information database - Ongoing
- Interim Progress Report (October 2003)

Year II - FY2004
Winter 2004
- Texas A&M processing of sidescan data collected in Fall 2003 - Ongoing
- Mapping (sidescan, CHIRP, and single-beam bathymetry) - Scheduled
- Winter/Spring fish sampling – Completed (January 04)
- UNO processing of fish for positive species identification - Ongoing

Spring 2004
- Fish sample work up
- UNO processing of fish for positive species identification

Summer 2004 *
- Summer fish sampling

Fall 2004
- Fish sample work up

Year III - FY2005
- Data analysis and synthesis
- Report preparation
- Manuscript preparation

*The Summer 2004 sampling cruise may be delayed until summer 2005, due to logistic constraints anticipated in summer 2004.

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Appendix A

Station Number Sabine 2003-01	Latitude North (WGS 84)	Longitude West (WGS 84)	Bottom Depth (m)	Bottom Dissolved Oxygen (mg/l)	Bottom Oxygen Percent Saturation
001	29° 29.51	93° 44.30	11	2.98	45.0
005	29° 29.10	93° 43.35	10	3.10	46.9
008	29° 31.82	93° 34.98	11	3.07	46.5
011	29° 30.52	93° 35.65	8	3.11	47.2
013	29° 30.53	93° 33.33	10	3.04	46.3
016	29° 29.8	93° 36.37	9	3.93	59.8
018	29° 29.39	93° 34.45	10	3.30	50.3
020	29° 29.25	93° 38.98	10	2.07	31.4
023	29° 28.52	93° 41.14	9	4.64	45.2
025	29° 27.54	93° 43.38	9	2.65	40.3
027	29° 27.68	93° 44.23	7	2.69	40.9
029	29° 28.34	93° 45.00	6	5.45	83.1
031	29° 25.05	93° 48.74	7	6.14	93.8
033	29° 25.12	93° 46.46	9	5.6	85.8
035	29° 24.17	93° 46.68	12	4.19	64.0
037	29° 24.49	93° 48.41	9	4.28	65.3
039	29° 28.22	93° 48.77	10	5.19	80.0
041	29° 27.50	93° 49.39	9	5.53	85.4
043	29° 26.28	93° 46.38	9	5.76	89.0
045	29° 26.39	93° 48.77	8	5.80	89.5
047	29° 25.81	93° 50.27	8	5.77	89.3
049	29° 24.30	93° 49.48	10	4.77	73.4
051	29° 23.11	93° 48.86	13	4.05	62.2
053	29° 23.00	93° 53.49	11	5.47	84.2
055	29° 21.78	93° 51.98	12	4.77	73.4
057	28° 21.48	93° 58.05	12	4.57	70.4
059	29° 21.09	93° 01.00	12	4.08	62.8
061	29° 21.47	94° 02.56	10	4.89	75.5
063	29° 23.35	93° 58.26	10	4.56	70.2
065	29° 24.71	93° 53.22	9	5.32	82.2
067	29° 24.76	93° 53.22	9	5.32	81.9
069	29° 24.60	93° 52.30	9	4.82	74.3
071	29° 28.43	93° 50.64	11	5.35	82.5

Appendix B

Hurricane Claudette – On the 8th July, 2003, Hurricane Claudette developed from what was a tropical storm in the Caribbean. It was not considered a threat to the Texas/Louisiana coast and coastal waters until the 13th of July at 10:00 AM when Brownsville, Texas came under a hurricane watch. Rainfall was estimated at 5-8 inches through the duration of the storm. NOAA Station No. 42035, located in Galveston approximately 38 nautical miles West of Sabine Bank, gauged wave heights on the 13th of July at 1.9 ft. Wave heights rose to a maximum of 3.4 ft.on the 14th of July and winds ranged from 1-7 mph until the later part of the day when winds topped out at 14 mph. On the 15th of July, from 10 AM to 2 PM, there was a tropical storm warning for the Texas coast North of High Island to Sabine Pass. The center of Claudette came within 138 miles of Sabine. Hurricane winds extended 30 miles from the center and tropical storm force winds extended 175 miles, mainly east, from the center. Wave heights recorded at Station 42035 maxed out at 5.4 ft and decreased through out the day, ending the day with wave heights of 2.5 ft. However, wind speeds continued to increase and were noted at 19 mph with gusts up to 25 mph. On the 15th of July, wind speeds dropped consistently and ranged from 6-11 mph. There was no notable change in water temperature pre- versus post-storm.